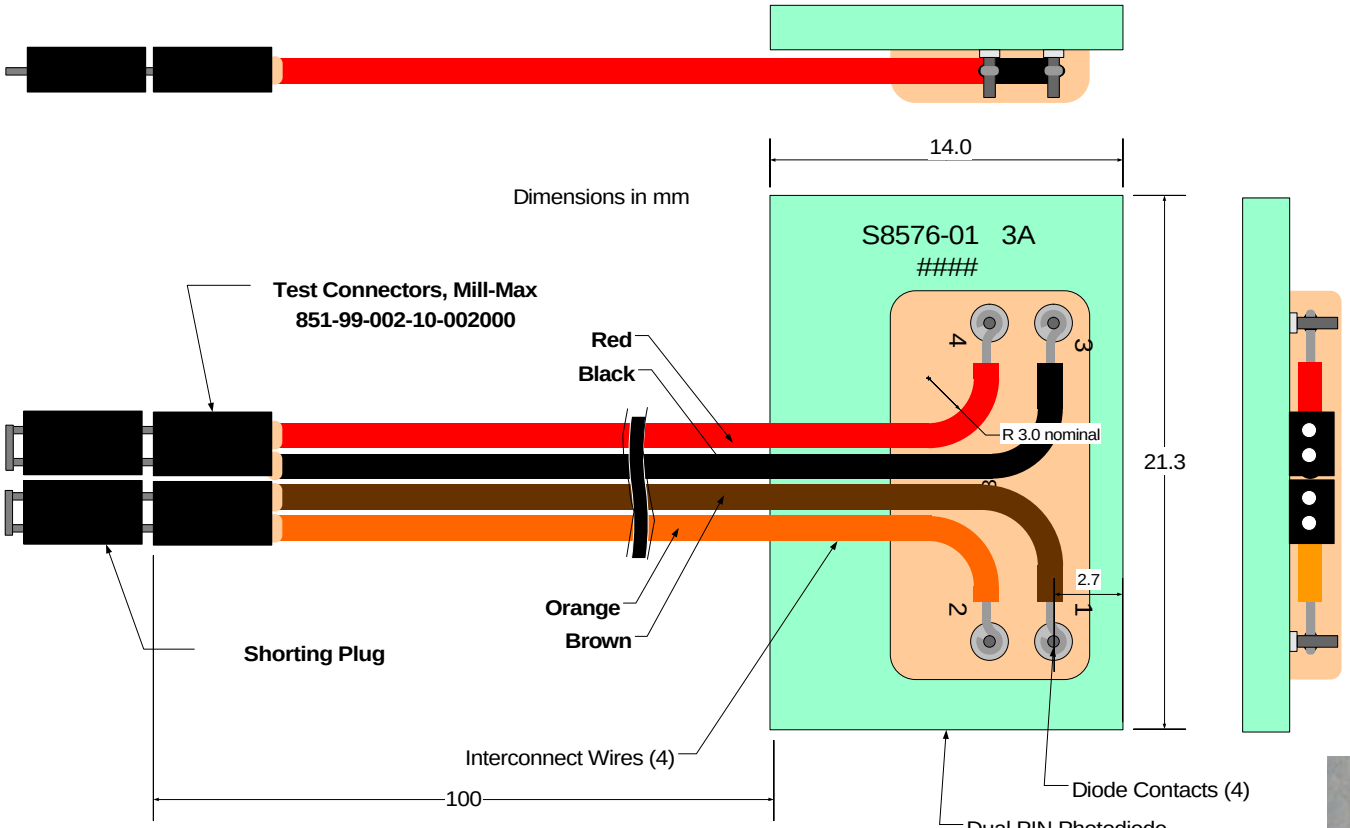
Photodiode Assembly Manufacturing Readiness Review

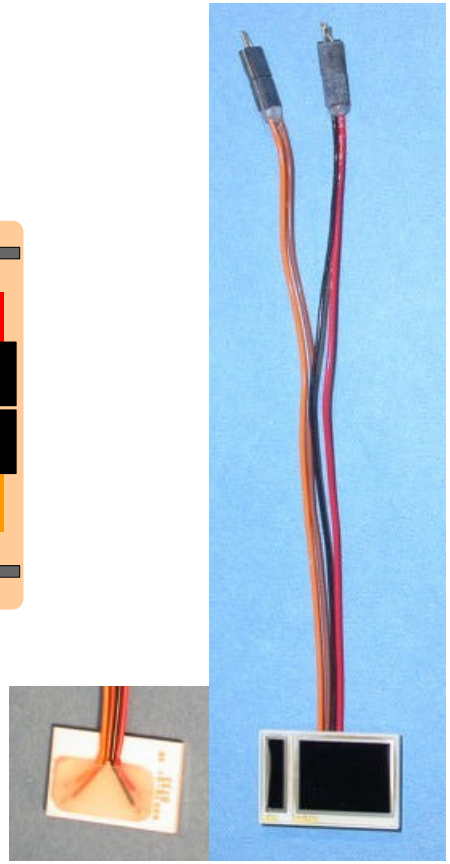
31 October 2003

Nick Virmani

Swales Aerospace

Photodiode Assembly





PDA Requirements

- **Applicable Documents**
  - **LAT-DS-00209-12: "GLAST LAT Calorimeter Flight Dual PIN Photodiode S8576-01 "**
  - **LAT-SS-01534-03: "Specification for the CAL Flight Model PIN Diode Assembly (PDA)"**
  - **LAT-PS-01330-04: "Calorimeter Process Specification for Assembly and Testing of Dual PIN Photodiode Assembly (PDA)"**
    - **This specification covers the PDA during various phases of its use which include:**
      - Assembly (DPD wire, soldering of DPD, and staking of wires and nonflight connectors)
      - In process and final inspections
      - Personnel certification requirement
      - Acceptance testing after assembly
      - Qualification
      - Storage
      - Packaging and Shipping

PDA Requirements (cont)

- **Applicable Documents (cont'd)**
  - **NASA-STD-8739.1: "NASA Technical Standard, Staking and Conformal Coating"**
  - **NASA-STD-8739.3: "NASA Technical Standard, Soldered Electrical Connections"**
  - **NASA-STD-8739.7: "NASA Technical Standard, Electrostatic Discharge (ESD) Control"**

PDA Assembly Process Materials

- **Dual PIN Photodiode (DPD)**
  - **Procured and tested to LAT-DS-00209-13 requirements.**
  - **LAT-DS-00209-12 by the Parts Control Board (PCB) and qualification performed by GSFC.**
  - **All materials tested, inspected and approved prior to assembly of PDA.**
  - **Only accepted material shipped to PDA supplier in ESD vacuum bagged containers.**
  - **Modified flight design DPDs are in production at Hamamatsu.**
    - **90 samples – completed 100 cycles -30 degrees C to +85 degrees C with no anomalies.**
    - **10 samples from the same lot at GSFC for further testing and examination.**
      - Completed visual and CSAM with no anomalies
  - **Flight lot diodes will be qualified at GSFC.**

PDA Assembly Process Materials (2)

- **Staking Material**
  - Urethane (uralane 5753 LV A/B with 7% CABOSIL) approved by GSFC.
  - Premixed material purchased from Appli-Tech with relevant documents.
  - Drop shipped material to PDA assembly house with all paper.
  - Shelf life and lot number maintained during usage of material on NRL generated work orders.
  - Materials stored in controlled storage.
- **Wires**
  - MIL-W-22759, AWG 28 – 7 strand, approved by the PCB, procured and inspected by NRL prior to delivery to PDA assembly house.

PDA Assembly Process Materials (3)

- **Assembly Fixtures**
  - Toolings and drawings under configuration control at NRL.
  - Toolings manufactured and verified by NRL prior to delivery to PDA assembly house.
  - Toolings designed to obtain the required tolerances and dimensions
  - 75 samples prepared using 3 sets of toolings.
  - 50 copies of the assembly fixtures will be used fro production requirement.
- **PDA Test Equipment**
  - Dedicated test equipment fabricated and verified by NRL, supplied to PDA vendor for final testing of 8 PDAs at a time.
  - Computer controlled test program is used for verification of leakage current.
  - Testing will be performed by NRL representative along with final inspection.

PDA Assembly Process Materials (4)

Traceability

- All manufacturing material, assembly, and test data traceability is maintained on NRL generated work orders and database for diodes, wires, staking material, and test data.
- Nonconformances controlled using NRL WOA database.
- All work at the PDA's assembly house performed using NRL generated work orders.
- WOAs, nonconformances and data is reviewed at the PDA's assembly prior to acceptance of PDAs and shipping to NRL.
- Only accepted PDAs shipped to Swales via NRL with relevant paperwork.

Storage and Shipping Containers

- Dedicated ESD shipping storage trays manufactured by Hamamatsu will be supplied by NRL to the PDA assembly house.
- PDAs shall be packaged in ESD shipping trays to avoid any stress and damage to the optical surface and to the wires. The process in place has been verified.

PDA Assembly

- PDA assembly performed by CapTron Corporation, Gaithersburg, MD
- ESD Training and Certification performed as per NASA standard.
- Soldering personnel certified to IPC standard J-STD-001 and are being certified to NASA standard during the 1st week of November at NASA training facility in Columbia, MD.
- Dedicated clean area used for assembly and storage.
- Assembly performed using NRL supplied material, assembly, and test fixtures using NRL generated WOA with NRL oversight.
- Inspection and testing performed by NRL representative.
- Facility and equipment in place for meeting production requirement.
- WOAs and test data reviewed at CapTron prior to shipping material to NRL.

PDA Manufacturing Flow (1)

Tested and PCB Approved Dual Photodiode (DPD) supplied by NRL

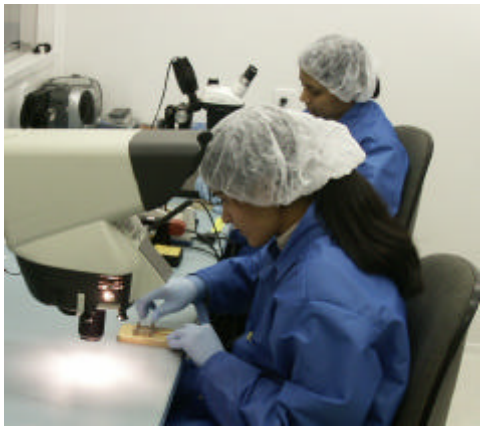
Fixture for lead cutting, soldering, staking and testing supplied by NRL

Cut the DPD leads using the fixture

MIL-STD Wires as per PCB approved parts list supplied by NRL

Cut and prep the wires for soldering

Solder the wires to the DPD as per NASA-STD-8739.3 using NRL supplied fixture as per LAT-PS-01330-04



Clean solder joints using ethyl alcohol

Inspect solder joints as per NASA-STD-8739.3

Cut and prepare other end of wire for soldering of non-flight connector

Solder of non-flight connectors as per NASA-STD-8739.3

Clean solder joints using ethyl alcohol

Inspect solder joints as per NASA-STD-8739.3

Staking of diode wires & connector as per NASA-STD-8739.1 by replacing the mask plates in the same NRL fixture setup

PDA Manufacturing Flow (2)

Cure staking material in the fixture for 1 hour at 25C and 1 hour at 85C

Inspect staking as per NASA-STD-8739.1 and height as per specification

Disassemble PDAs from fixture, perform visual inspection, and clean surfaces as required

Store PDAs in ESD Trays supplied by NRL

Test PDAs using test fixture supplied by NRL & record data

Assemble two non-flight shorting plugs and install

Clean the PDAs optical surface using clean room swab as specified herein if required.

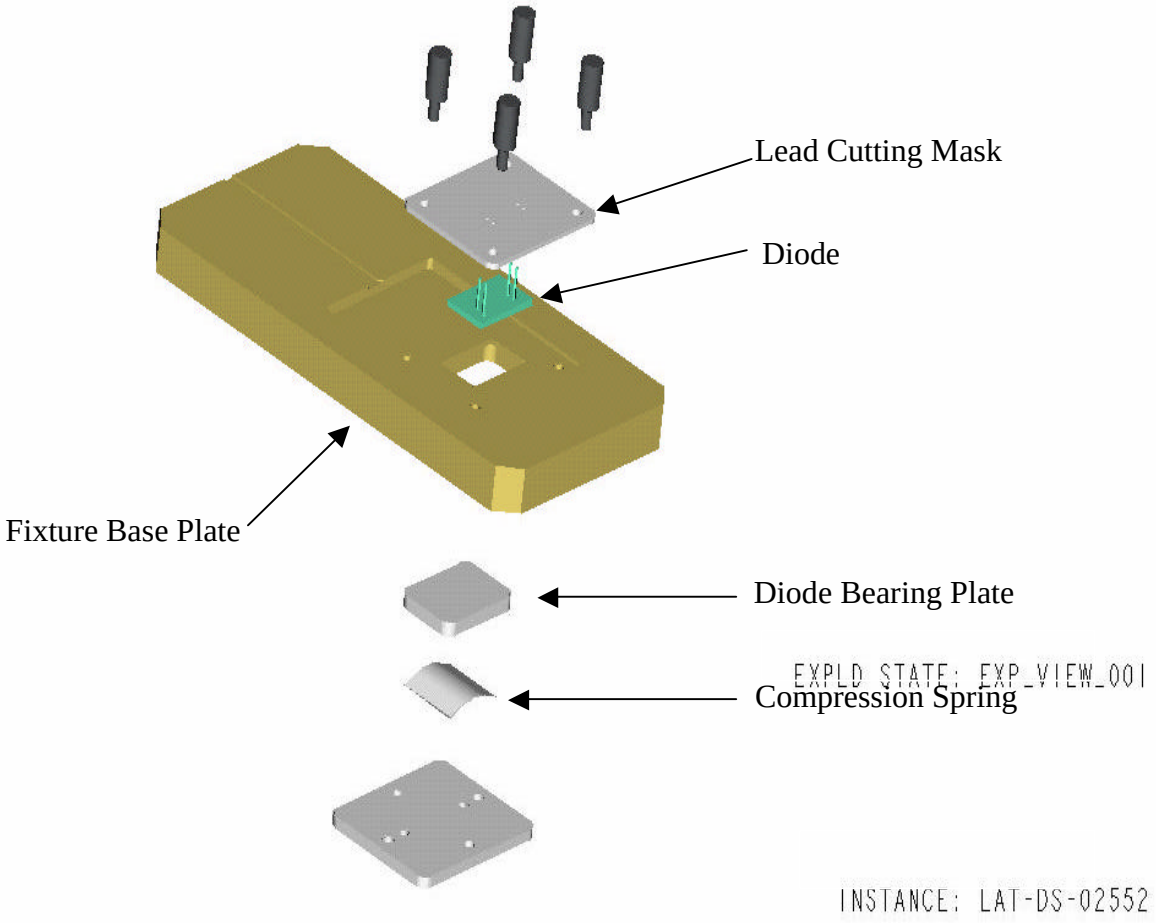
Inspect PDAs

Pack the PDAs in the NRL supplied ESD packages and review data package

Vacuum seal the bags

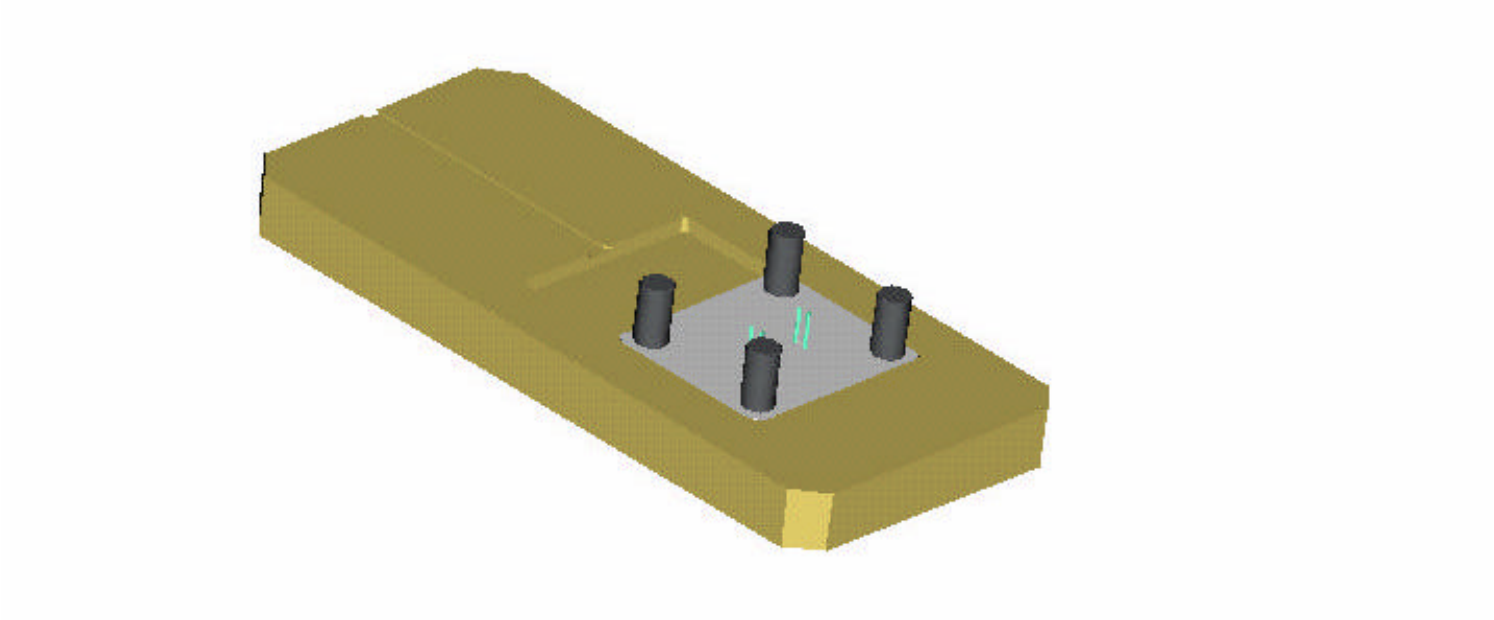
Ship to NRL with documents as specified herein

PDA Manufacturing Tooling



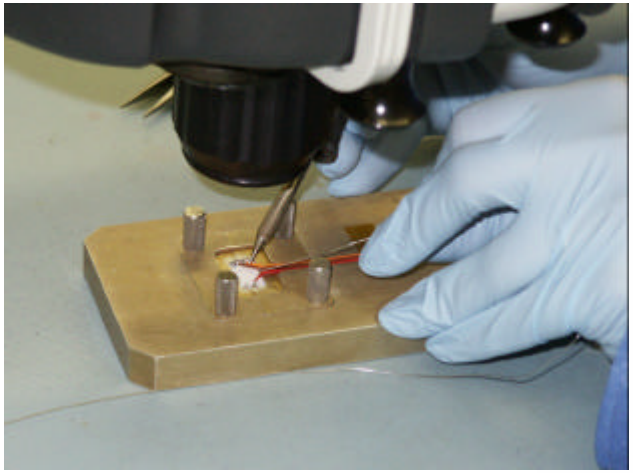
Exploded View of Tooling Configured to Cut PIN Diode Leads

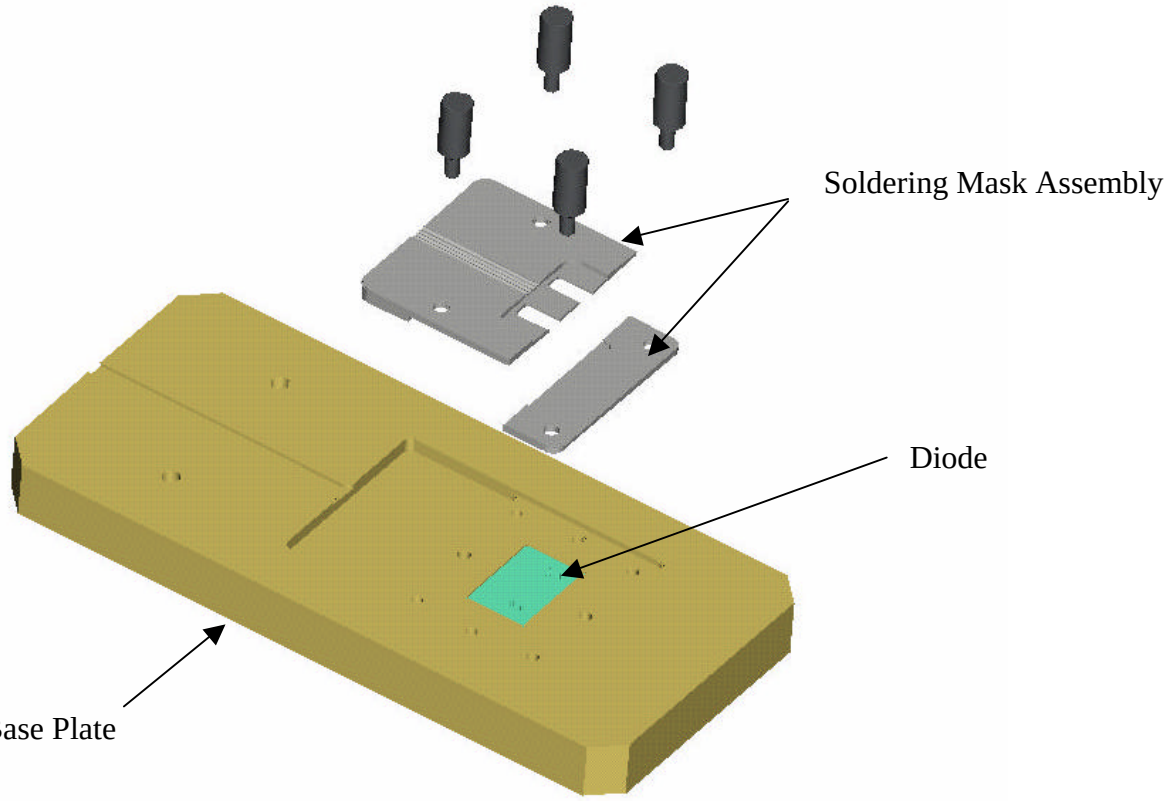
PDA Manufacturing Tooling (2)



Assembled View of Tooling Configured to Cut PIN Diode Leads

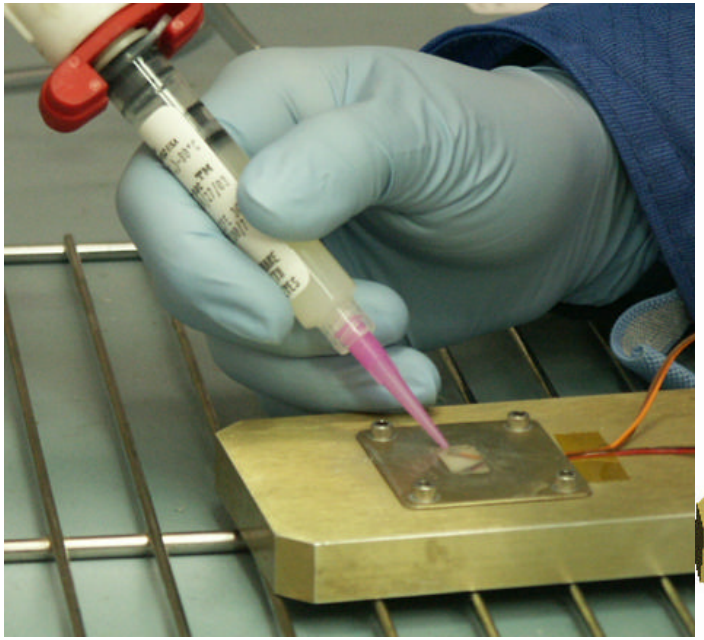
PDA Manufacturing Tooling (3)

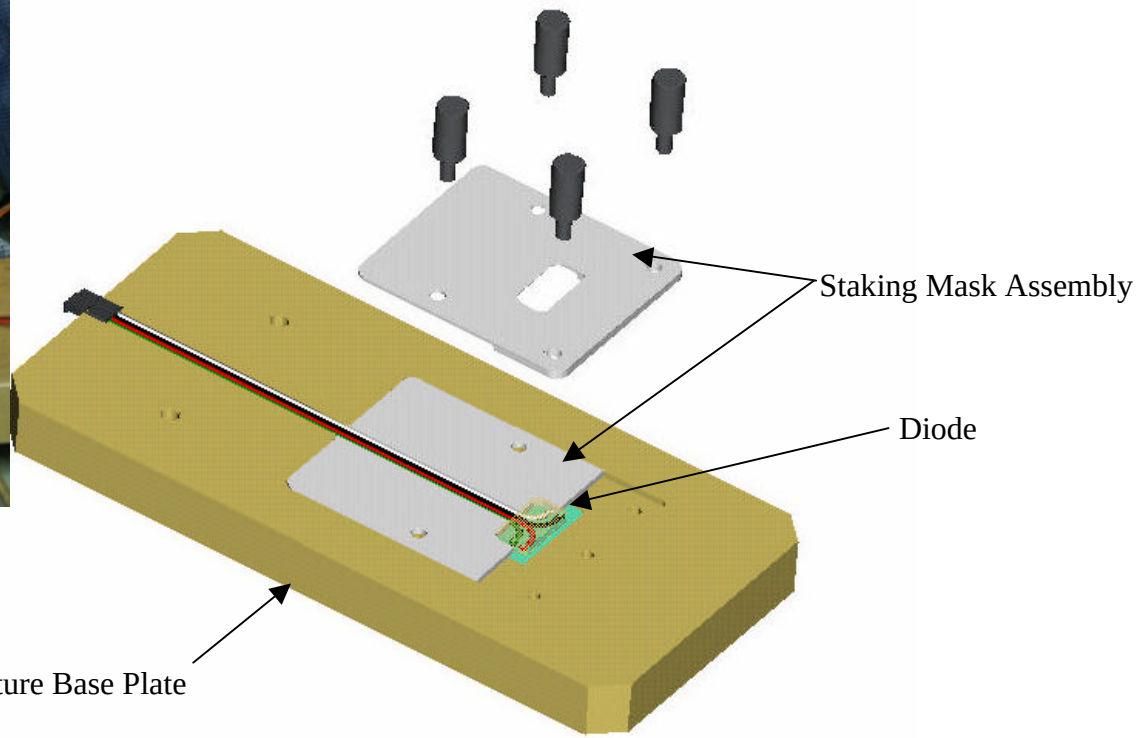




Exploded View of Tooling Configured to Solder PIN Diode Leads

PDA Manufacturing Tooling (4)



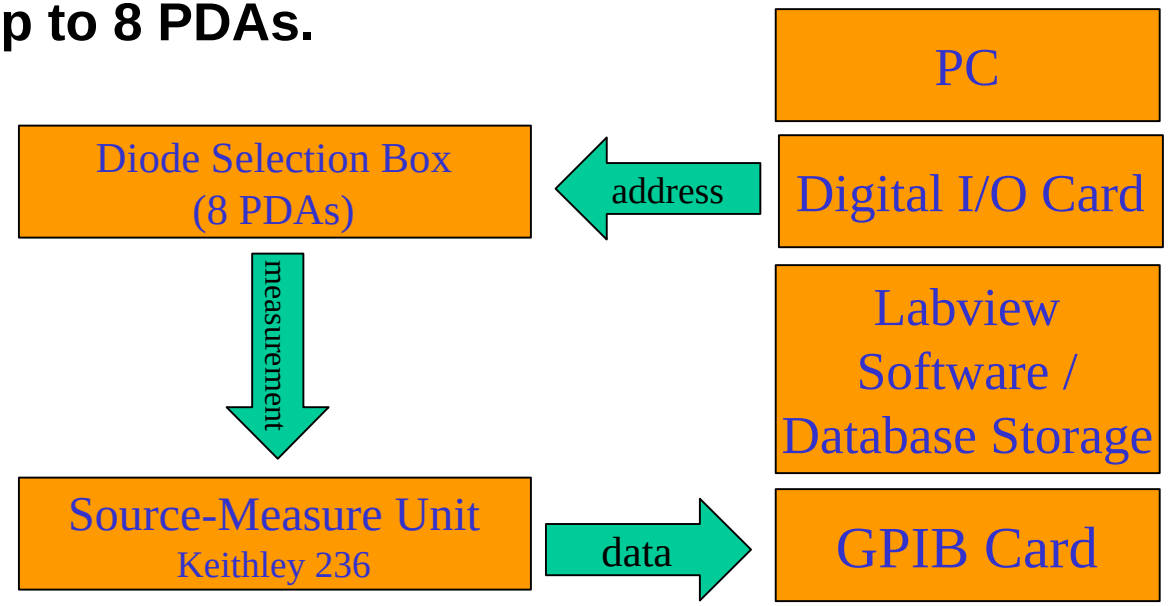


Exploded View of Tooling Configured to Stake PIN Diode Leads

PDA Leakage Current Test System

The Diode Selection Box uses addressable relay drivers to control up to 8 PDAs.

PC automatically selects and records PDA leakage current and accept/reject.



Source-Measure unit converts leakage current into a digital signal readable by the PC via GBIP.

Risk Reduction Activities

- PDA concept and materials were developed and tested in over 200 units assembled for the EM CAL module. No failures have occurred thru qualification level environmental testing.
- Flight PDA specification and processes have been improved
  - Dual diode electrical pin positions have been changed
  - Lessons learned in assembly have improved manufacturability.
- To date, 75 PDAs assembled, inspected, and tested using NRL WOA database. No anomalies observed.
- CapTron continuing to streamline processes to increase productivity.
- System in place for transfer of material from NRL to CapTron/Swales.

Parts and Tooling Status

- **Parts – GFE from NRL to CapTron**
  - Flight Dual PIN Diodes are the limiting factor in start of production.
    - First parts expected 25 Nov.
    - Delivery rate 300 diodes per week.
  - Flight wires and non-flight test connectors have been delivered to NRL.
  - Uralane is delivered to NRL in small lots due to limited storage life.
- **Tools – GFE from NRL to CapTron**
  - CapTron has three sets of prototype tooling being used to refine process.
  - Drawings for final flight tooling have been released by NRL.
  - Vendor selection scheduled for 31 Oct.
  - 50 sets of tooling will be provided to support manufacturing rate of >150 PDA/week.